Coyote Creek Flood Control
Reach 1A Marsh Management Area
2002 Soils Monitoring Report

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COYOTE CREEK
FLOOD CONTROL PROJECT
REACH 1A MARSH MANAGEMENT AREA
2002 SOILS MONITORING REPORT

Prepared by:

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TABLE OF CONTENTS

INTRODUCTION 1
METHODS 4
RESULTS 5
  SOIL pH 5
  SOIL SALINITY 5
DISCUSSION 7
LITERATURE CITED 11

FIGURES:

Figure 1. Vicinity Map 2
Figure 2. Coyote Creek Reach 1A: Soil Sample Locations 3
Figure 3. Comparison of mean soil salinity by grouping and total annual precipitation for the years 1996-2002. 7
Figure 4. Mean annual salinity of the soil samples (mean by station groups from both spring and fall sampling) with periods of tidal influence indicated. 9

TABLES:

Table 1. pH of soil samples obtained from Coyote Creek Reach 1A on May 28, and October 8, 2002. 5
Table 2. Salinity of soil samples obtained from Coyote Creek Reach 1A on May 28 and October 6, 2002. 6

APPENDIX:

APPENDIX A. Vegetation Map of Coyote Creek Reach 1A From SCVWD (2001) 12

INTRODUCTION

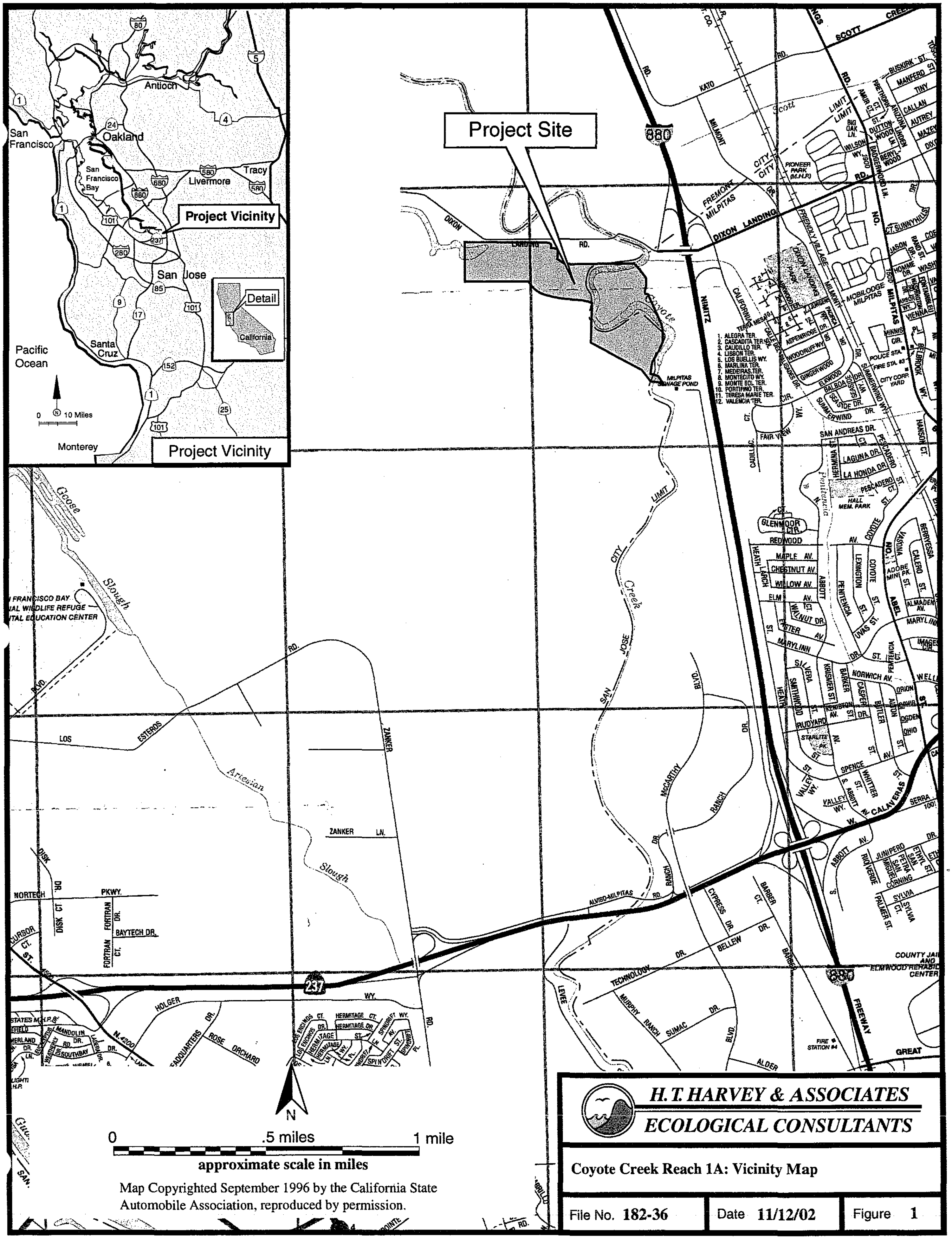
The Santa Clara Valley Water District (SCVWD) Coyote Creek Flood Control Project Marsh Management Area is situated along Reach 1A of the Lower Coyote Creek. It is located west of Highway 880 and north of Highway 237 in Santa Clara County, California (Figure 1). The Coyote Creek Reach 1A Marsh Management area was developed as mitigation for the Lower Coyote Creek Flood Control Project. It was designed to provide managed, diked pickleweed marsh and associated peripheral halophytes for escape cover for the resident population of salt marsh harvest mice.

Management activities were described in the Operation and Maintenance Manual for Coyote Creek Reach 1A (OMM) (H.T. Harvey & Associates 1989) and the Monitoring Plan (H.T. Harvey & Associates1991). Monitoring of soil salinity and pH was prescribed and has been conducted annually since 1991.

The site was primarily diked marsh prior to its designation as a mitigation site. The area is part of a flood control by-pass channel system that was developed to route high flows from Coyote Creek. Flood flows, when they enter the site, generally leave the mitigation area inundated for several weeks. In combination with winter precipitation, these flows have the potential to reduce site soil salinity.

Over the ten years since site construction, management for soil salinity and soil moisture has been the major challenge of the site, as these factors have limited the spread of pickleweed on the site. The original design called for periodic inundation of tidal waters through controlled flooding via tide gates. However, the installation of these gates was delayed. Therefore, the opportunity to manage the site as a muted tidal system with appropriately sized culverts (instead of a diked/managed marsh) was designed and attempted in 1998. However, drainage of the site was not as predicted, leaving large portions of the site inundated. Since that time, flap gates have been installed, allowing for periods of controlled flooding, which was accomplished twice in 2002 (Doug Padley, pers. comm.).

This report details the results of soil sampling completed in 2002, and relates the results to prior management actions and rainfall patterns. Observations were also made on vegetation characteristics at each soil sample location and related to the measured soil parameters.



approximate scale in miles

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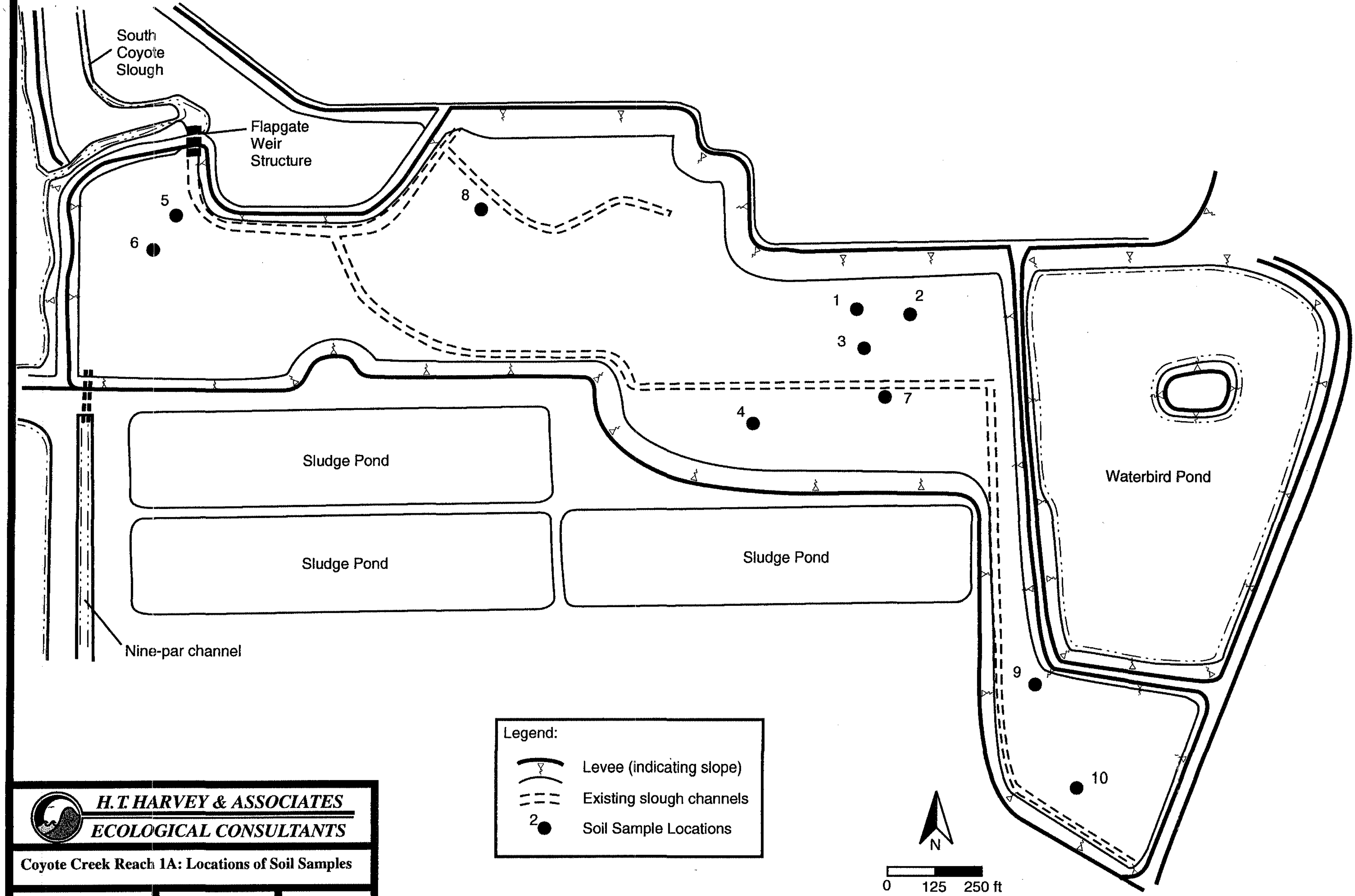
Coyote Creek Reach 1A: Vicinity Map

File No. **182-36** | Date **11/12/02** | Figure **1**



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Coyote Creek Reach 1A: Locations of Soil Samples

File No. **182-36**
Date **11/12/02**
Figure **2**

METHODS

Soils within the management area were sampled on 28 May (spring sample) and 8 October (fall sample) 2002. Soil samples were taken at ten locations established during the 1993 field surveys (Figure 2). Soil sample locations were established at that time in three different vegetation zones with replicate samples in each zone. During the June 1998 sampling, the soil sample locations were permanently marked with ½-inch PVC pipe to facilitate accurate repeated measurements of soil salinity. Soil samples were collected using a 1-inch diameter soil-coring device and were taken from the upper 12 inches of the surface horizon. Five 12-inch soil cores were randomly collected within a 5-foot radius of each sample location. The five cores were combined to create a single composite sample at each location.

The soil samples were delivered to Soil and Plant Laboratory Inc. in Santa Clara, California for analysis. Electrical conductivity (EC) was measured in saturated sample extracts and pH was determined from saturated soil pastes. EC (uS/cm) was converted to salinity (ppt), S, via a fourth order equation in post processing:

$$S = (5.995\text{x}10^{-8})[(EC/1000)^4] - (2.312\text{x}10^{5})[(EC/1000)^3] + (3.4346\text{x}10^{-3})[(EC/1000)^2] + (5.3532\text{x}10^{-1})(EC/1000) - (1.5494\text{x}10^{-2})$$

In addition to analyzing these data by location, salinity was averaged among soil sample locations that exhibited similar plant associations and/or are in close proximity to one another.

In addition to soil sampling, vegetation species composition, density, health and vigor were recorded at each soil sample location. The vegetation was observed within the same 5-foot radius where soil samples are collected. These observations were compared with previous observations, among sampling dates (seasonality), and with observations made in the latest H. T. Harvey & Associates' report on salt marsh harvest mouse use at Coyote Creek Reach 1A (2001b).

RESULTS

SOIL pH

The soil pH results are presented in Table 1. Soil pH was near neutral to just basic (6.8-7.5) for all locations and decreased slightly from spring to fall. Vegetation observations are also recorded in Tables 1 and 2 (dominant plant species and health and vigor).

Table 1. pH of soil samples obtained from Coyote Creek Reach 1A on May 28, and October 8, 2002.

Sample Number	Dominant Plant Species	Health and Vigor*	May 2002 pH	October 2002 pH
1	Bare ground with pickleweed	Low	7.1	7.2
2	Bare ground with pickleweed	Medium	7.2	7.2
3	Pickleweed and bare ground	Medium	7.3	7.0
4	Pickleweed	Low	7.4	7.2
5	Peppergrass	Managed*	7.0	6.8
6	Alkali heath with peppergrass	High and Managed*	7.2	6.9
7	Pickleweed	Medium	7.1	6.8
8	Italian rye grass with alkali heath	Managed* and Medium	7.6	7.5
9	Italian rye grass	Dead	7.3	6.8
10	Italian rye grass	Dead	7.4	7.1
Average			**7.26**	**7.05**

* Health and Vigor ratings are from the October 2002 sampling date. 'Managed' indicates that control activities (e.g. manual removal) of non-native vegetation (e.g. peppergrass) had recently occurred.

SOIL SALINITY

Soil salinity data from samples collected in the spring (28 May) and fall (8 October) of 2002 are presented in Table 2. The site exhibited high spatial and temporal variation in soil salinity with salinities ranging from 4.9 to 49.9 ppt (average 20 ppt) in spring and from 10.5 to 85.3 ppt (average 35.2 ppt) in fall. Soil salinity was highest in areas dominated by pickleweed and bare ground (soil sample locations 1, 2, 3, 4, and 7) and lowest in areas dominated by perennial peppergrass (*Lepidium latifolium*), Italian ryegrass (*Lolium multiflorum*), and alkali heath (*Frankenia salina*) (soil sample locations 5, 6, 8, 9, and 10). Soil salinity was higher in fall 2002 (compared to spring 2002) at all locations.

Stations exhibiting similar vegetation communities and soil salinity trends were grouped in earlier reports (e.g. Stations 1, 2, and 3). Soil stations with higher mean salinities (1, 2, 3, 4, and 7) support pickleweed vegetation, whereas lower soil salinity stations (5, 6, 8, 9, and 10) support intermediate salinity marsh plants and/or ruderal grasses.

Table 2. Salinity of soil samples obtained from Coyote Creek Reach 1A on May 28 and October 6, 2002.

Sample Number	Dominant Plant Species	Health and Vigor*	May 2002 Salinity (ppt)	October 2002 Salinity (ppt)
1	Bare ground with pickleweed	Low	49.9	62.1
2	Bare ground with pickleweed	Medium	43.3	85.3
3	Pickleweed and bare ground	Medium	22.8	48.5
4	Pickleweed	Low	21.0	37.5
5	Peppergrass	Managed*	4.9	10.5
6	Alkali heath with peppergrass	High and Managed*	6.1	14.3
7	Pickleweed	Medium	27.2	46.5
8	Italian rye grass with alkali heath	Managed* and Medium	5.8	10.9
9	Italian rye grass	Dead	9.1	20.3
10	Italian rye grass	Dead	9.7	16.1
Average			**20.0**	**35.2**

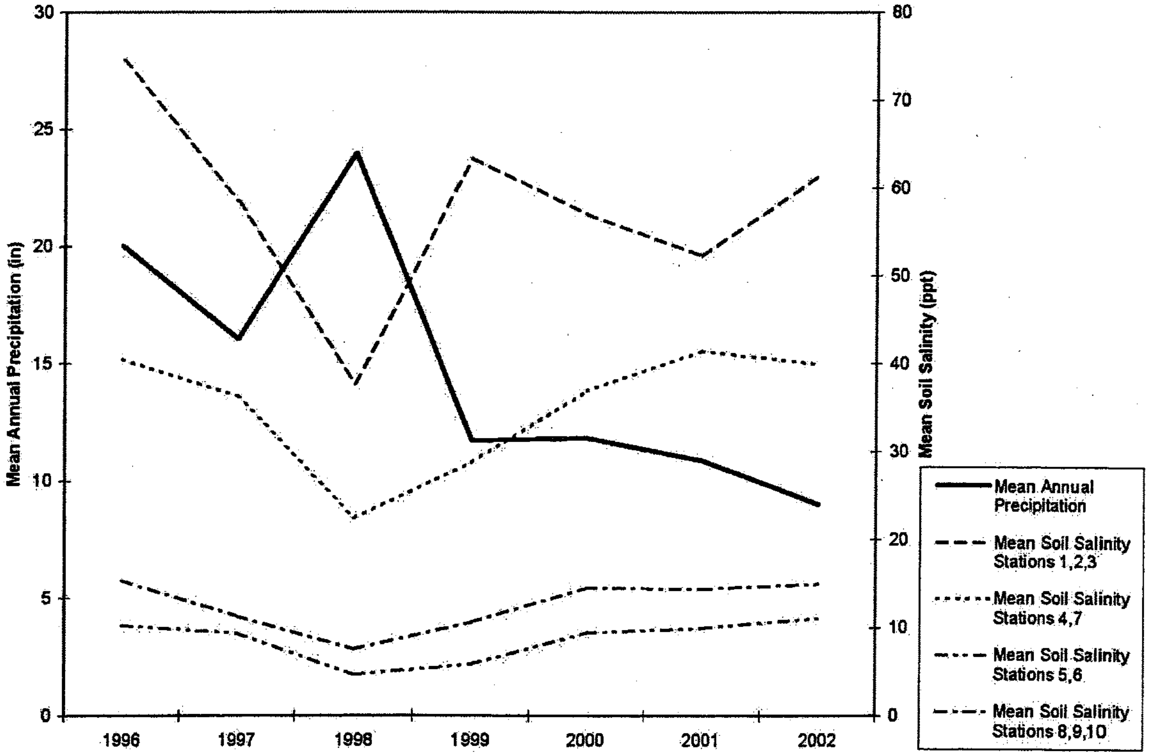
* Health and Vigor ratings are from the October 2002 sampling date. 'Managed' indicates that control activities (e.g. manual removal) of non-native vegetation (e.g. peppergrass) had recently occurred.

DISCUSSION

The fluctuation in soil salinity on an annual basis is a function of multiple factors including flooding, management and climatic factors. In some areas a lack of soil moisture appears to limit the quality of pickleweed habitat more than other factors. In other areas, low soil salinity appears to allow the invasion of less stress-tolerant plant species.

Rainfall and temperature (which influences evapotranspiration) vary both inter- and intra-annually, altering the amount of water available in the site's soils. The relationship of the site's soil salinity to total annual rainfall is shown in Figure 3 below.

Figure 3. Comparison of mean soil salinity by grouping and total annual precipitation for the years 1996-2002.



Note: the period 1992-1995 is not included due missing samples (seasonally). Mean Annual Precipitation data is from the San Jose, CA weather station available at www.wrcc.dri.edu. The 2002 precipitation data was normalized by including the October-December recent averages (1992-2001), as these month's data were not available at the time of this report.

Levee breaches in 1997 and 1998 left portions of the site inundated. In 1998, structures were put in place to convert the area to muted tidal marsh, but the site did not drain as predicted, and the gates were subsequently closed. The management regime as stated in the OMM (H. T. Harvey & Associates 1989) relies on proper operation of the tidegate to create soil conditions necessary for the support of a diked pickleweed-dominated salt marsh community upstream of a brackish marsh. The proper operation of the tidegate relies upon sufficient monitoring in order to fine-tune its operation. The following is a summary of the monitoring to date, and its relationship to the guidelines as stated in the OMM.

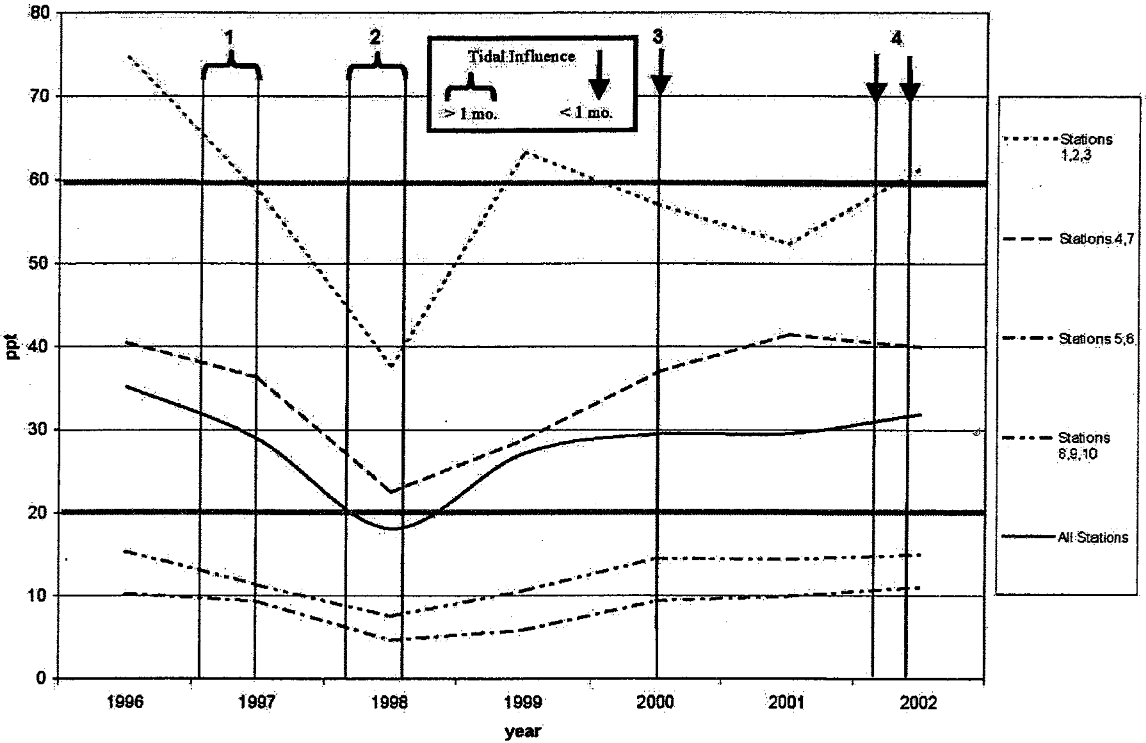
- Monitoring from 1992 to the present has focused upon soil salinity and pH (with qualitative vegetation observations), and salt marsh harvest mouse trapping (SMHM - not discussed here). The bulk of the vegetation observations have been a part of the SMHM trapping report, and detailed vegetation community mapping performed by the District, most recently in 2001 (Appendix A). Vegetation observations performed in conjunction with the soil salinity monitoring are qualitative.

- The soil salinity sampling allows the performance of the site to be tracked in regards to the target salinity range. This relationship is shown in Figure 4 along with all known occurrences of tidal action in the project site during the shown monitoring period. The frequency of flood events in the channel is unknown. Figure 4 is focused on the period of 1996 to the present since the years 1992 to 1995 are missing data (see note below Figure 3).

- The soil salinity for all sampling sites when averaged collectively (i.e. all stations lumped together) is generally within the soil salinity range stated in the OMM. However, when the Station groups are looked at individually, only Station groups 1, 2, 3 and 4, 7 are within the OMM salinity range (Figure 4). In correspondence with these salinity numbers, these portions of the site (Station groups 1, 2, 3 and 4, 7) support pickleweed (albeit at low cover values and stunted growth forms) whereas other portions (Station groups 5, 6 and 8, 9, 10) do not support pickleweed and are vegetated with other salt and brackish marsh plants or ruderal grasses (Table 2). Therefore, it is more useful to look at the site in terms of the Station groups to better understand the spatial variability observed in both the soil salinity and vegetation composition. Stations 5 and 6 are in areas that were originally diked pickleweed marsh prior to project installation, but would currently be classified as brackish marsh. The location (closer to the water control structure) and elevation of these sites may make the re-establishment of pickleweed very difficult. Stations 9 and 10 are in an area of the site that was set aside for upland escape habitat for the salt marsh harvest mouse during flooding events. Therefore, the site salinity range goals do not apply to those stations.

- The spatial variability in the vegetation communities on the site can largely be explained by the soil salinities measured at those stations. However, the low-to-medium health and vigor of the pickleweed (see Tables 1 and 2) is not merely a function of salinity, as this species is able to withstand salinities as high as 80 ppt. The health and vigor of the pickleweed at this site is related to both soil salinity and soil moisture. Pickleweed is a middle marsh, tidal wetland plant that can tolerate drought conditions; however, it does not thrive in continual drought conditions. In the areas containing pickleweed, bare ground is either the dominant or sub-dominant component of the community. A lack of soil moisture, necessary to promote growth and vegetative propagation, is likely the cause of the poor health and vigor of the pickleweed on the site.

Figure 4. Mean annual salinity of the soil samples (mean by station groups from both spring and fall sampling) with periods of tidal influence indicated.



Note: Vertical bars note the introduction of tidal action into the site. The bracket shows events that lasted longer than one month; the arrow shows an event that was less than one month. The heavy gray bars at 20ppt and 60ppt show the original OMM salinity range guideline (H. T. Harvey & Associates, 1989).

- Elevation has also been shown to be influential on the soil salinity, and therefore soil moisture, gradients of coastal marshes (Zedler et al. 1999, St. Omer 1994). The distribution of plant communities in wetland systems is usually controlled by the interaction of precipitation and floodwaters with elevation (Callaway et. al. 1989, Callaway and Sabraw 1994, Zedler, 1983). It appears from observations made in the field that salinity differences among Station groups could be influenced, at least partially, by differential elevations. The relationship between elevation and plant community distribution (Appendix A) could be better elucidated through new, detailed topographic surveys of the site. Unfortunately, no as-built topographic maps were developed after the flood control project was completed.

- Although the District has never formally adopted the OMM, the site (excluding the waterbird pond) does not appear to have achieved the vegetation cover goals (60% pickleweed cover and 90% total vegetative cover) as stated in the OMM (H. T. Harvey & Associates, 1989). The pickleweed does not appear to have exceeded 1-foot in average height, and large portions of the site that were expected to be, are not pickleweed-dominated (around Stations 5, 6 and 8). Although soil moisture has not been monitored, it is likely contributing to low pickleweed health and vigor.

In summary, there are two primary issues at the Coyote Creek Reach 1A project site that should be addressed. First, the salinities should be increased in order to exclude less salt tolerant species that are presently out-competing pickleweed. Secondly, soil moisture must be increased (while keeping soil salinities high) in order to increase the range and density of pickleweed habitat, while continue to exclude other less tolerant halophytes. This is especially important during summer months when soil moisture deficits appear to be stressing the pickleweed. Therefore, it is recommended that the management of the Coyote Creek Reach 1A project site should follow the guidelines established in the OMM. Specifically, this should include active management of the water control structure to increase or maintain high soil salinities and increase soil moisture.

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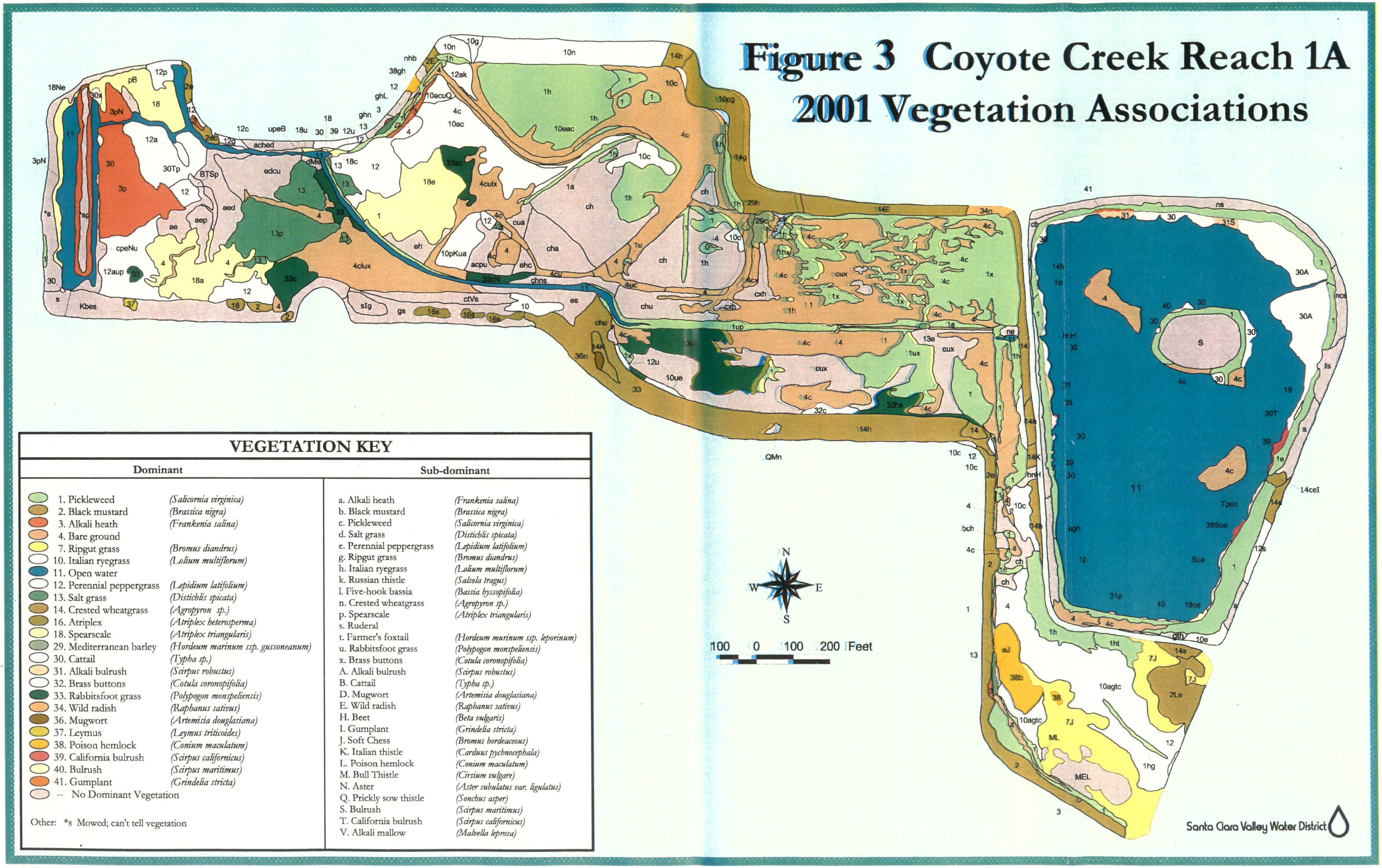
APPENDIX A.
Vegetation Map of Coyote Creek Reach 1A From SCVWD (2001)

Figure 3 Coyote Creek Reach 1A
2001 Vegetation Associations



VEGETATION KEY

Dominant

🟩	1. Pickleweed	*(Salicornia virginica)*
🟫	2. Black mustard	*(Brassica nigra)*
🟥	3. Alkali heath	*(Frankenia salina)*
🟧	4. Bare ground	
🟨	7. Ripgut grass	*(Bromus diandrus)*
⬜	10. Italian ryegrass	*(Lolium multiflorum)*
🟦	11. Open water	
⬜	12. Perennial peppergrass	*(Lepidium latifolium)*
🟩	13. Salt grass	*(Distichlis spicata)*
🟫	14. Crested wheatgrass	*(Agropyron sp.)*
🟫	16. Atriplex	*(Atriplex heterosperma)*
🟨	18. Spearscale	*(Atriplex triangularis)*
🟩	29. Mediterranean barley	*(Hordeum marinum ssp. gussoneanum)*
⬜	30. Cattail	*(Typha sp.)*
🟧	31. Alkali bulrush	*(Scirpus robustus)*
⬜	32. Brass buttons	*(Cotula coronopifolia)*
🟩	33. Rabbitsfoot grass	*(Polypogon monspeliensis)*
🟧	34. Wild radish	*(Raphanus sativus)*
🟫	36. Mugwort	*(Artemisia douglasiana)*
🟨	37. Leymus	*(Leymus triticoides)*
🟧	38. Poison hemlock	*(Conium maculatum)*
🟥	39. California bulrush	*(Scirpus californicus)*
🟨	40. Bulrush	*(Scirpus maritimus)*
🟧	41. Gumplant	*(Grindelia stricta)*
⬜	-- No Dominant Vegetation	

Other: *s Mowed; can't tell vegetation

Sub-dominant

a. Alkali heath	*(Frankenia salina)*
b. Black mustard	*(Brassica nigra)*
c. Pickleweed	*(Salicornia virginica)*
d. Salt grass	*(Distichlis spicata)*
e. Perennial peppergrass	*(Lepidium latifolium)*
g. Ripgut grass	*(Bromus diandrus)*
h. Italian ryegrass	*(Lolium multiflorum)*
k. Russian thistle	*(Salsola tragus)*
l. Five-hook bassia	*(Bassia hyssopifolia)*
n. Crested wheatgrass	*(Agropyron sp.)*
p. Spearscale	*(Atriplex triangularis)*
s. Ruderal	
t. Farmer's foxtail	*(Hordeum murinum ssp. leporinum)*
u. Rabbitsfoot grass	*(Polypogon monspeliensis)*
x. Brass buttons	*(Cotula coronopifolia)*
A. Alkali bulrush	*(Scirpus robustus)*
B. Cattail	*(Typha sp.)*
D. Mugwort	*(Artemisia douglasiana)*
E. Wild radish	*(Raphanus sativus)*
H. Beet	*(Beta vulgaris)*
I. Gumplant	*(Grindelia stricta)*
J. Soft Chess	*(Bromus hordeaceous)*
K. Italian thistle	*(Carduus pychnocephala)*
L. Poison hemlock	*(Conium maculatum)*
M. Bull Thistle	*(Cirsium vulgare)*
N. Aster	*(Aster subulatus var. ligulatus)*
Q. Prickly sow thistle	*(Sonchus asper)*
S. Bulrush	*(Scirpus maritimus)*
T. California bulrush	*(Scirpus californicus)*
V. Alkali mallow	*(Malvella leprosa)*

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